In The Name

Of

GOD

Hamid Moghaddasi

Professor of Health Information Management
&
Medical Informatics

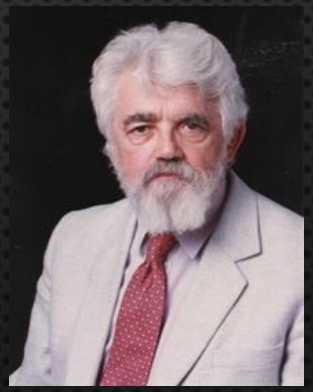
Shahid Beheshti University of Medical Sciences

Early History of AI

In 1950 English mathematician Alan Turing wrote a landmark paper titled “Computing Machinery and Intelligence” that asked the question:

“Can machines think?”

He is widely considered to be the father of theoretical computer science and artificial intelligence.



Further work came out of a 1956 workshop at Dartmouth sponsored by John McCarthy. In the proposal for that workshop, he coined the phrase a “study of artificial intelligence”

- **On "What is intelligence?" McCarthy said:**
- **On "What is artificial intelligence?" he answered:**
- **On whether a solid definition of artificial intelligence that distinguishes it from human intelligence, he stated:**

John McCarthy (September 4, 1927 – October 24, 2011) was an American computer scientist and cognitive scientist. He was one of the founders of the discipline of artificial intelligence. He received many accolades and honors, such as the 1971 Turing Award for his contributions to the topic of AI.

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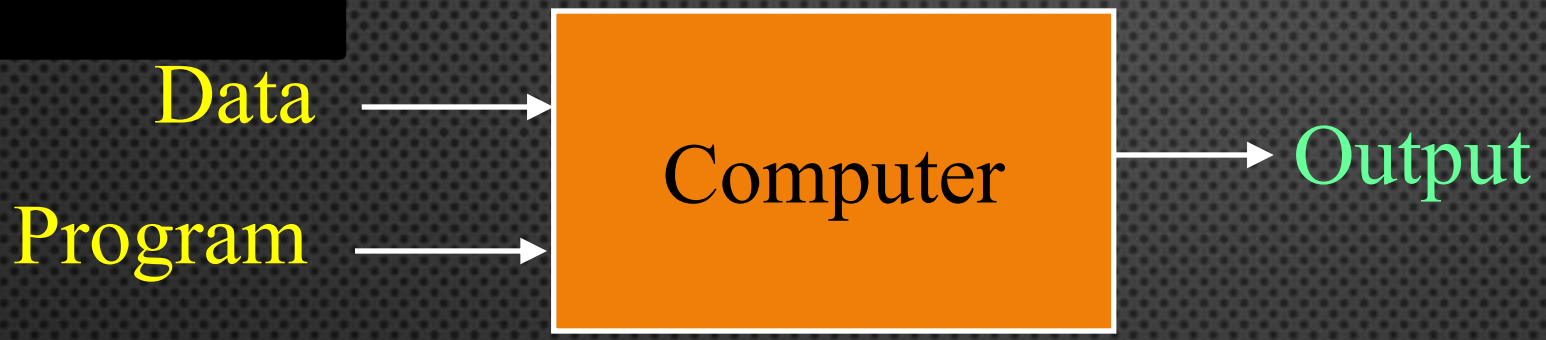
Artificial Intelligence

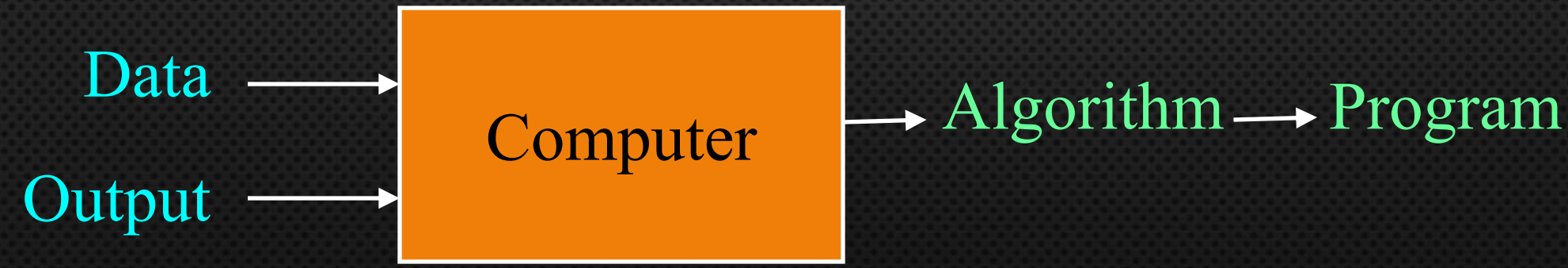
- Machine Learning
- Robotics

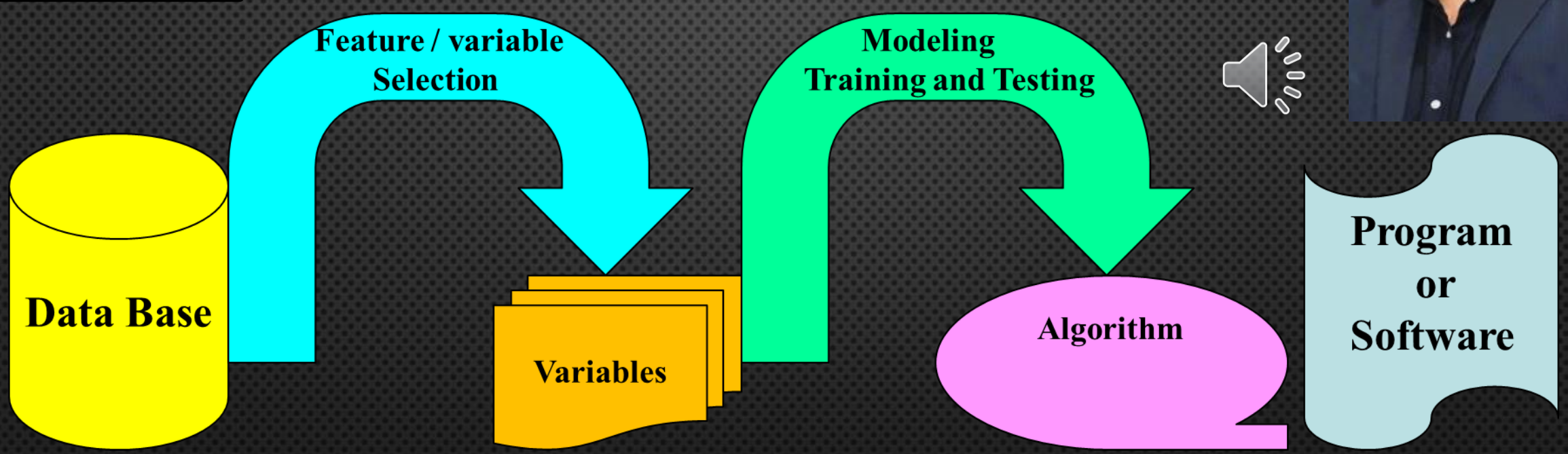
[redacted]

Traditional Programming



Machine Learning




Feature / variable
Selection
Modeling
Training and Testing
Data Base
Variables
Algorithm
Program
or
Software

Magic?

No, more like gardening

Gardener = You
Nutrients = Data

- **Seeds** = Algorithms
- **Plants** = Programs

AI and HIV

Why is AI important in infectious diseases?

- The large volume of health data, epidemiological, and human-behavior data
- The very short golden window for diagnosis
- **Faster and more accurate diagnosis can save many lives**
- **AI = speed + accuracy + prediction**
- A tool for clinics, laboratories, and policymaking

Epidemic prediction and control

- Applying Machine Learning to analyze:
  - Flight and mobility data
  - Weather and seasonal variations
  - Social media and news
- Early Warning systems → forecasting disease trends

Examples:

- COVID-19, Dengue fever, Ebola

Practical Examples

- **BlueDot (2019)** → Early warning for COVID-19
- **HealthMap** (Harvard, 2006) → Disease tracking through news and web data
- **Metabiota(2008)** → Transmission risk modeling for governments
- **Google Trends + AI** → Detecting symptom signals before hospital visits

Advantages

- **Reduced diagnostic delay:** Faster diagnosis = faster treatment = lower mortality
- **Cost reduction:** Less human labor, shorter time, mass screening
- **Increased study capacity:** One AI model can review thousands of images or records in minutes
- **Improved quality of care:** Eliminates errors due to fatigue

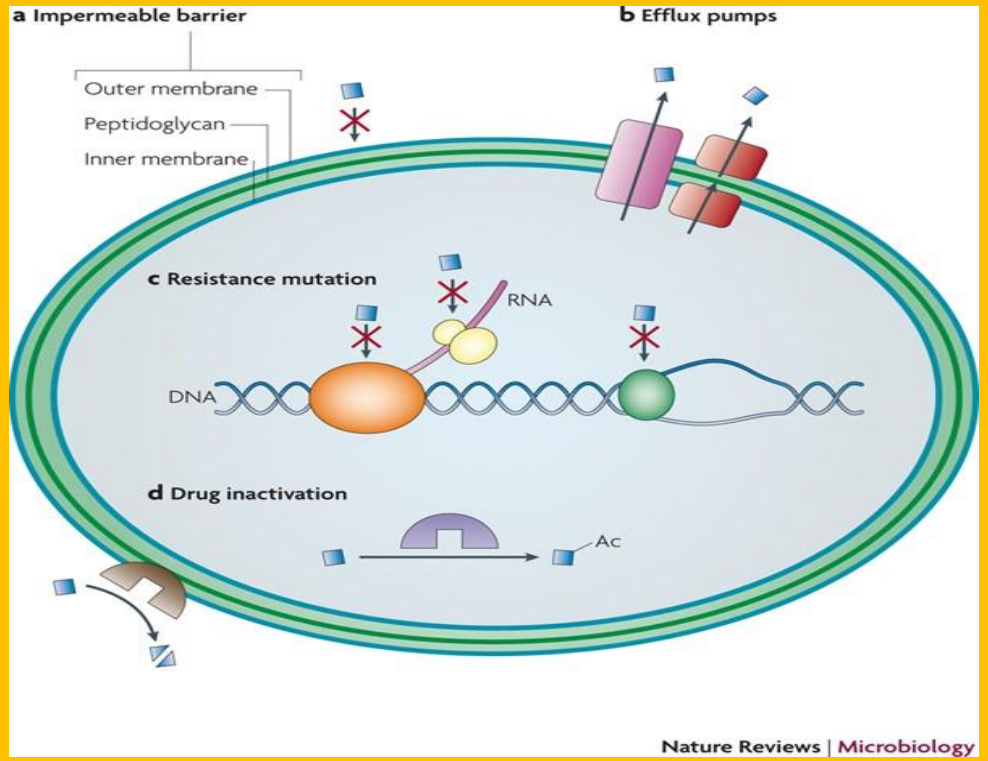
AI is not a replacement for physicians, but a powerful enhancer of medical capability.

We are entering the post-antibiotic era; if we don't act today, it will be too late tomorrow.

AI and Antimicrobial Resistance (AMR)

- A global health threat
- Ordinary bacteria → deadly again
- WHO warning: AMR deaths may surpass cancer deaths
- **AI = reduced unnecessary use + drug discovery + targeted treatment**

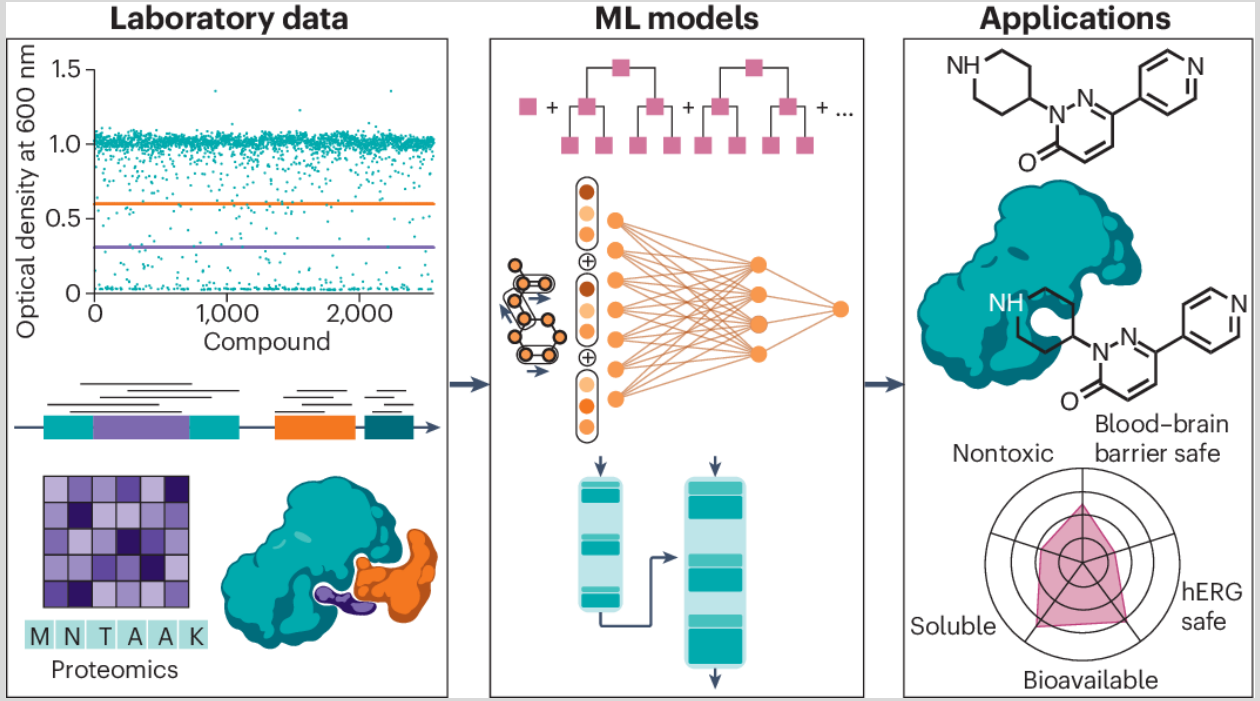
- The genome of each bacterium contains clues about its resistance.

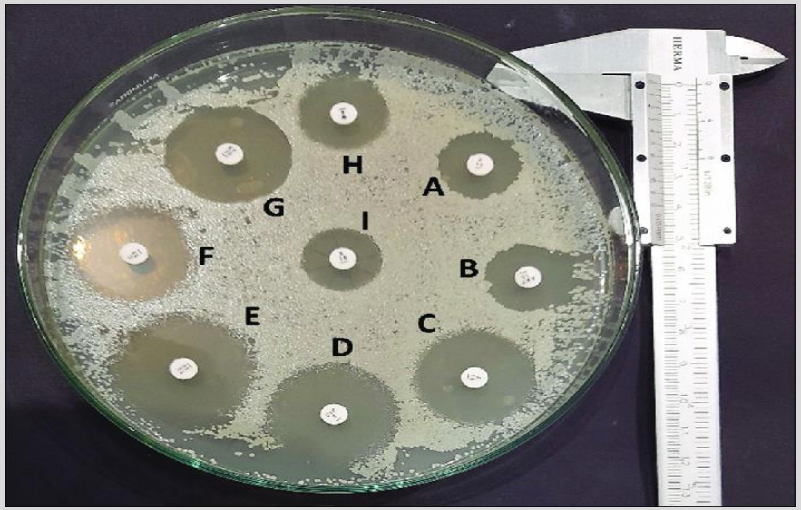


- AI, by analyzing DNA sequences, can indicate:
  - **Which drugs the strain is resistant to**
  - **Which drugs it is sensitive to**

Tools:

- CARD پایگاه داده ژن‌های مقاومت آنتی‌بیوتیکی
- DeepARG
- ResFinder


Laboratory data
ML models
Applications
Optical density at 600 nm
1.5
1.0
0.5
0
0
1,000
2,000
Compound
M N T A A K
Proteomics
NH
N
O
Blood–brain barrier safe
Nontoxic
hERG safe
Soluble
Bioavailable


A
B
C
D
E
F
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H
I

Discovery of new antibiotics

Classic problem:

- Developing new antibiotics is very slow, expensive, and high-risk.
- Many molecules are eliminated in early stages.

- Deep Learning for screening millions of molecules
- Reducing development cost and time

Example:

- Discovery of **Halicin** by an AI model (MIT)
- Platforms: Atomwise and IBM RXNS

- AI not only helps **discover new antibiotics**, but also
- **Predicts which strains** are resistant to which drugs, and
- **Reduces the spread of resistance** through intelligent prescribing.

- **Important note:**
  AI is a screening tool; definitive diagnosis is only possible through laboratory tests (ELISA, PCR)

Role of AI in HIV

- Faster diagnosis
- Personalized treatment (ART)
- Follow-up and monitoring
- Improving Urban/population epidemiology

AI is effective in analyzing urban and population-level epidemiological data to better control the spread of HIV.

How AI Can Help Physicians Diagnose HIV/AIDS

- **Interpreting Rapid HIV Tests (Rapid Diagnostic Tests):**

A machine-learning model on a mobile phone can analyze images of rapid HIV tests (RDTs) and determine positive/negative results with high accuracy. One study reported that a machine classifier achieved 98.9% accuracy in determining test outcomes, while human interpretation (visual reading) of these tests had a higher error rate. *EATG*


HIV
C T

HIV (Rapid Diagnostic Test – RDT) and AI

AI can:

- Analyze the test strip image via a mobile phone
- Detect color intensity and lines more accurately than the human eye
- Reduce human interpretation errors and increase screening speed

How AI Can Help Physicians Diagnose HIV/AIDS

- **Using Clinical and Laboratory Data to Classify HIV Status:**

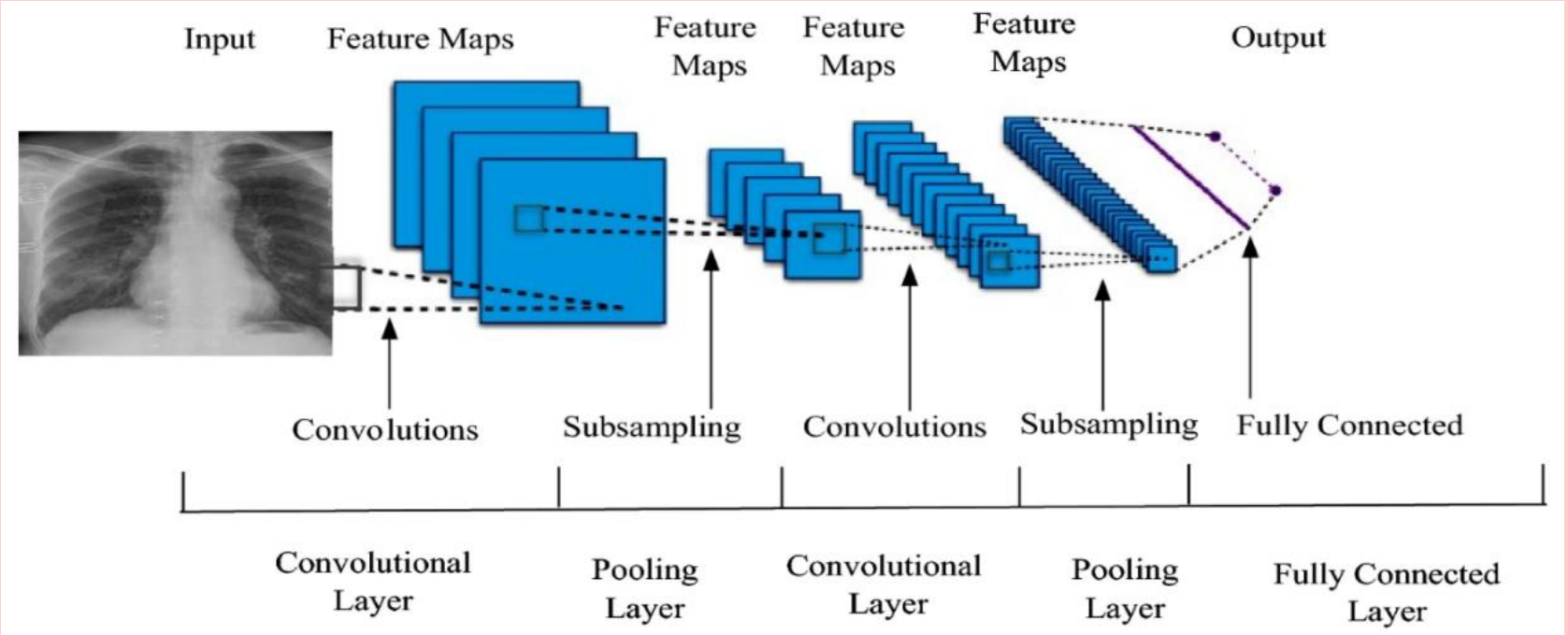
A newly developed machine-learning framework—based on laboratory data such as CD4/CD8 counts and other blood tests—was able to identify HIV infection status.

In a study published in Scientific Reports (Nature Publishing Group), the model achieved an overall accuracy of about 89%.

Nature

How AI Can Help Physicians Diagnose HIV/AIDS

- **Opportunistic Detection Using Radiographic Images (X-ray):** In another study, AI analyzed chest X-ray images of patients with tuberculosis (TB) and was able to detect signs associated with HIV coinfection.
This approach may serve as an "opportunistic screening" tool in regions where HIV testing is limited. PLOS



Computer Vision plays a major role in faster and more accurate disease detection, especially in identifying TB from X-ray images. Solutions such as CAD4TB, DeepTB, and Qure.ai have demonstrated strong performance in this area.

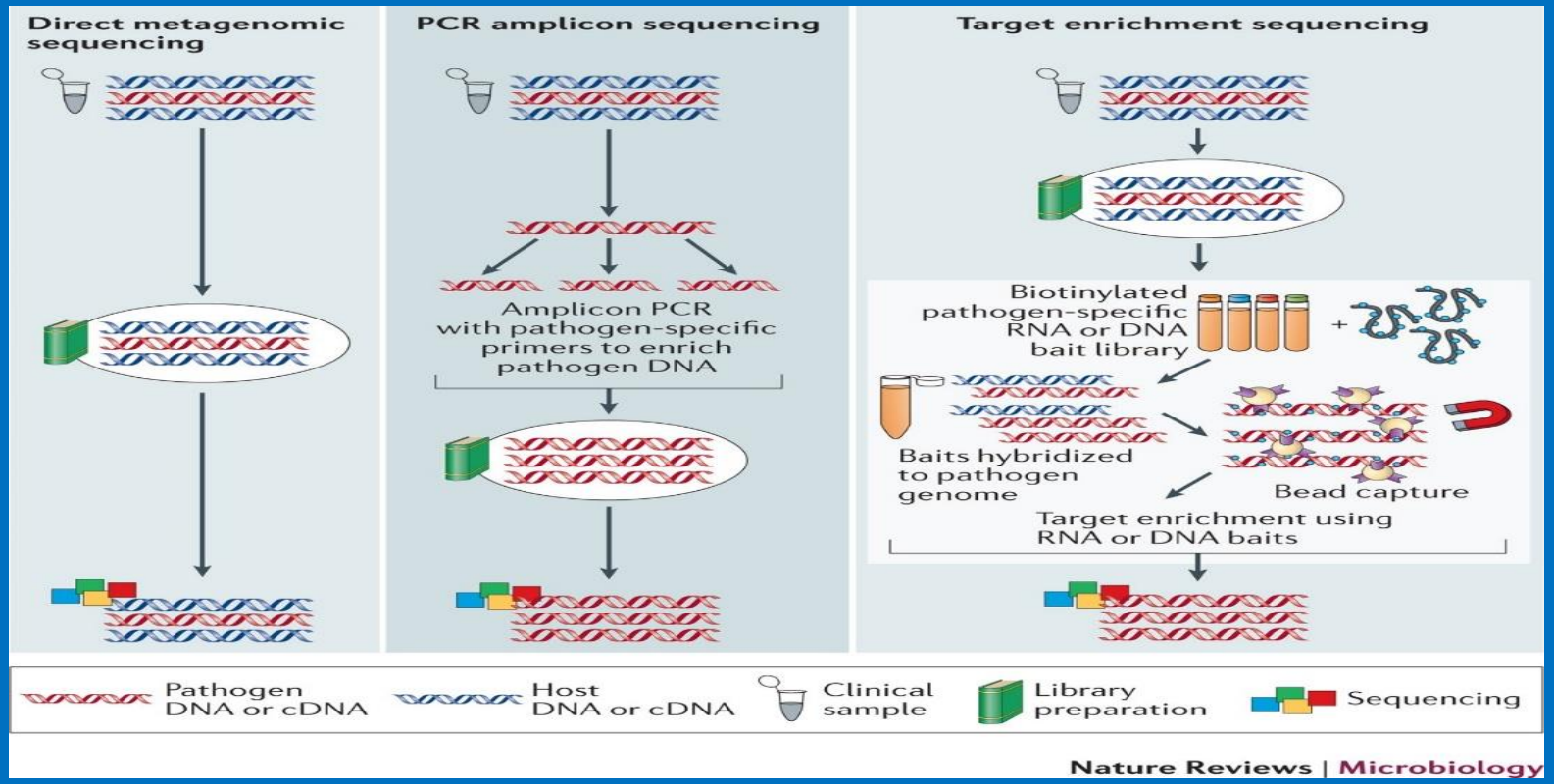
How AI Can Help Physicians Diagnose HIV/AIDS

- **Clinical Decision Support:**

Overall, a systematic review has shown that AI in HIV care can be effective across different stages—testing, retention in care, virologic prediction, immune status (CD4), and associated complications. *PubMed*

Personalized ART Regimen Selection

(AI-Guided ART)


Direct metagenomic sequencing
PCR amplicon sequencing
Target enrichment sequencing
Amplicon PCR with pathogen-specific primers to enrich pathogen DNA
Biotinylated pathogen-specific RNA or DNA bait library
Baits hybridized to pathogen genome
Bead capture
Target enrichment using RNA or DNA baits
Pathogen DNA or cDNA
Host DNA or cDNA
Clinical sample
Library preparation
Sequencing
Nature Reviews | Microbiology


Truvada

ART Regimen Selection

- Human immunodeficiency **viruses** (HIV) **mutates** → some **antiretroviral drugs become ineffective**
- AI through genome analysis:
    - o Predicting resistance
    - o Suggesting optimal drug combinations

Tools:

- Stanford HIVdb (TCE)
- geno2pheno
- EuResist

Patient Follow-up and Monitoring

- **Predicting patients at risk of:**
  - o Non-adherence to medication
  - o Drop-out from treatment
  - o Side effects
- **Care chatbots:**
  - o Medication reminders
  - o Answering questions
  - o Detecting non-adherence patterns

Examples:

- **HIVsmart!**
- **Watson Assistant + EMR**
- **Wysa / Woebot (mental health)**

HIV Epidemiology

- HIV epidemiology Can be analyzed **using Transmission network models**
- **The models help identifying** high-risk clusters and pinpoint areas with the highest virus transmission.
- With this information, **optimal allocation of preventive resources** such as PrEP (**Pre-Exposure Prophylaxis**) and treatment with ART becomes possible.

Tools:

- **UNAIDS Spectrum**
- **EpiModel**
- **DHIS2**

AI- Mobile App for People Living with HIV

- **The PositiveLinks app** was designed by a team at the University of Virginia** and its initial version was developed in 2013 and piloted at the **Ryan White Clinic** in Central Virginia, USA.
- **Follow-up & Monitoring:** Daily check-ins, medication reminders, appointment alerts
- **Peer Support:** Anonymous community message board to reduce stigma and loneliness
- **Clinic Connection:** Direct link to care team for coordination and help
- **Result**: Better engagement in care, higher CD4, and reduced viral load.

Ethical and Safety Challenges

- Privacy, especially for HIV and genomic data
- Training data bias (Race / Gender / Socioeconomic)
- Model intransparency (Black box)

- **AI = supportive tool; final decision = physician**

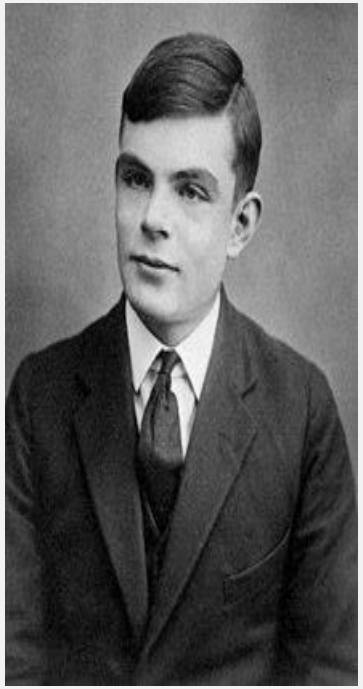
HIV/AIDS Section Summary

- AI → the physician's second eye
- AI speeds up HIV diagnosis → reduces transmission, enables earlier treatment initiation
- AI personalizes therapy → selects optimal ART, prevents treatment failure
- AI sustains long-term care → supports adherence, behavioral monitoring, mental health
- AI improves public health → identifies transmission clusters, enables targeted interventions

"In HIV, AI is not a luxury tool, but a lifesaving solution."

Thank you
for
your attention

Any Question?



Alan Mathison Turing (23 June 1912 – 7 June 1954) was an **English mathematician, computer scientist, logician, cryptanalyst, philosopher, and theoretical biologist**.[6]

Turing was highly influential in the development of **theoretical computer science**, providing a **formalization** of the concepts of **algorithm** and **computation** with the **Turing machine**, which can be considered a model of a general-purpose computer.[7][8][9]

He is widely considered to be the father of theoretical computer science and **artificial intelligence**.[10]

The Turing Test

(Can Machine think? A. M. Turing, 1950)

A test to empirically determine whether a computer has achieved intelligence

- Requires
  - Natural language
  - Knowledge representation
  - Automated reasoning
  - Machine learning
  - (vision, robotics) for full test

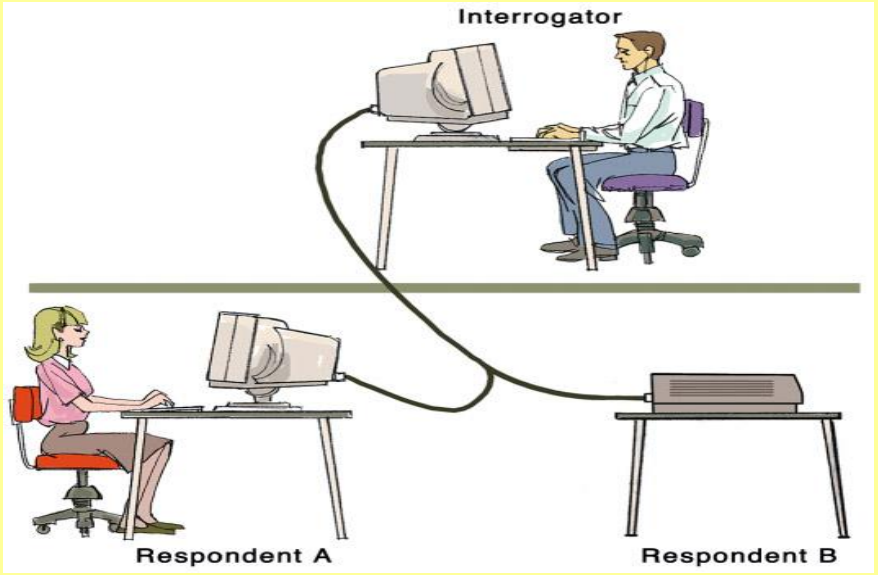
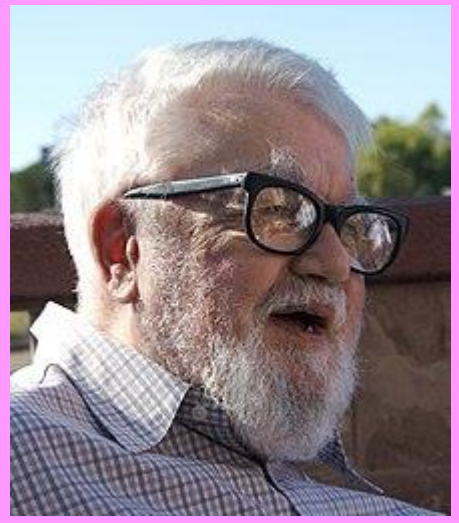


Figure 13.2
In a Turing test, the interrogator must determine which respondent is the computer and which is the human

A reversed form of the Turing test is widely used on the Internet; the CAPTCHA test is intended to determine whether the user is a human or a computer.

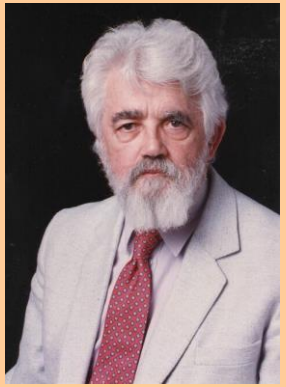
John McCarthy (September 4, 1927 – October 24, 2011) was an American computer scientist and cognitive scientist. He was one of the founders of the discipline of artificial intelligence.[1]



He co-authored the document that coined the term "artificial intelligence" (AI), developed the programming language family Lisp, significantly influenced the design of the language ALGOL, popularized time-sharing, and invented garbage collection.

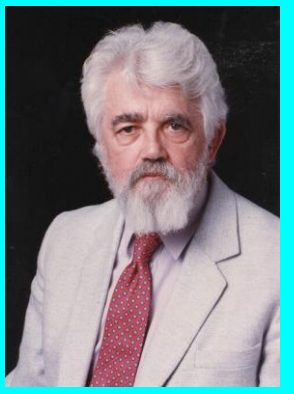
He received many accolades and honors, such as the 1971 Turing Award for his contributions to the topic of AI.

What is Artificial Intelligence (John McCarthy , Basic Questions)



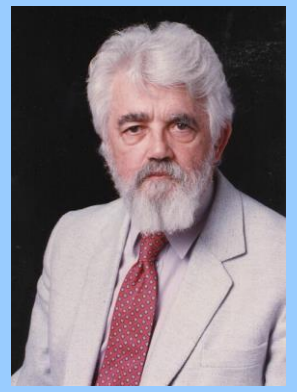
- **Yes, but what is intelligence?**
- Intelligence is the computational part of the ability to achieve goals in the world. Varying kinds and degrees of intelligence occur in people, many animals and some machines.

What is Artificial Intelligence (John McCarthy , Basic Questions)



- **What is artificial intelligence?**
- It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, **but AI does not have to confine itself to methods that are biologically observable.**

What is Artificial Intelligence (John McCarthy , Basic Questions)



- **Isn't there a solid definition of artificial intelligence that doesn't depend on relating it to human intelligence?**
- Not yet. The problem is that we cannot yet characterize in general what kinds of computational procedures we want to call intelligent. We understand some of the mechanisms of intelligence and not others.

- **More in: http://www-formal.stanford.edu/jmc/whatisai/node1.html**

Views of AI fall into four categories:

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally